行政院國家科學委員會專題研究計畫 成果報告

環境評估的模型構建-以垃圾焚化爐為例
研究成果報告(精簡版)

計 畫 類 別 ：個別型
計 畫 編 號 ：NSC 95-2416-H-343-002-
執 行 期 間 ：95 年 08 月 01 日至 96 年 07 月 31 日
執 行 單 位 ：南華大學環境管理研究所

計 畫 主 持 人：陳中獎

計畫參與人員：碩士班研究生-兼任助理：林正傑、陳依兌

處 理 方 式 ：本計畫可公開查詢

中 華 民 國 96 年 10 月 08 日

行政院國家科學委員會補助專題研究計畫 ■ 成 果 報 告 □期中進度報告

（計畫名稱）

計畫類別：■ 個別型計畫　　□ 整合型計畫
計畫編號：NSC　－　　－　－　　－　　－
執行期間：　95 年　8 月 1 日至　96 年　7 月 31 日

計畫主持人：陳中獎
共同主持人：
計畫參與人員：

成果報告類型(依經費核定清單規定繳交)：■精簡報告　□完整報告

本成果報告包括以下應繳交之附件：
□赴國外出差或研習心得報告一份
□赴大陸地區出差或研習心得報告一份
□出席國際學術會議心得報告及發表之論文各一份
□國際合作研究計畫國外研究報告書一份

處理方式：除產學合作研究計畫、提升產業技術及人才培育研究計畫、列管計畫及下列情形者外，得立即公開查詢
□涉及專利或其他智慧財產權，□一年□二年後可公開查詢

執行單位：

中　華　民　國　　96　年　10　月　8　日

1. Introduction

Environmental impact assessment (EIA) is one of the key instruments of environmental policy to avoid environmental conflicts for the project development. It has been adopted as a platform among stakeholders for information communication about development proposals so that environmental damage can be avoided or minimized, and is widespread recognized as an effective tool for supporting the sustainable development of the environment through policy, plan and program decision-making processes. A great number of literature focus on this issues (e.g. Noble, 2000; Partidario, 2000) for the discussion of methodology (e.g. Noble and Storey, 2001; Brown and Therivel, 2000; Verheem and Tonk, 2000), or performance criteria (e.g. Fischer, 2002; IAIA, 2002; Nitz and Brown, 2000).

The EIA Act (Taiwan) was the first Taiwan environmental law that call for a comprehensive assessment of environmental consequences, was legalized and implemented in 1994. It regulates minimum requirements for ensuring the achievement to meet the social objectives, and prescribes the assessment procedures, the composition of assessors, and the level of details of the outcome report to ensure information transparence. However, the environmental conflicts still maintained at a quite high level (please see Figure 1) even increased oven time. This situation implies that SEAs remain less than satisfactory and improvements in the quality of SEA decisions are required (see, e.g. Hazell and Benevides, 2000; Curran et al., 1998).

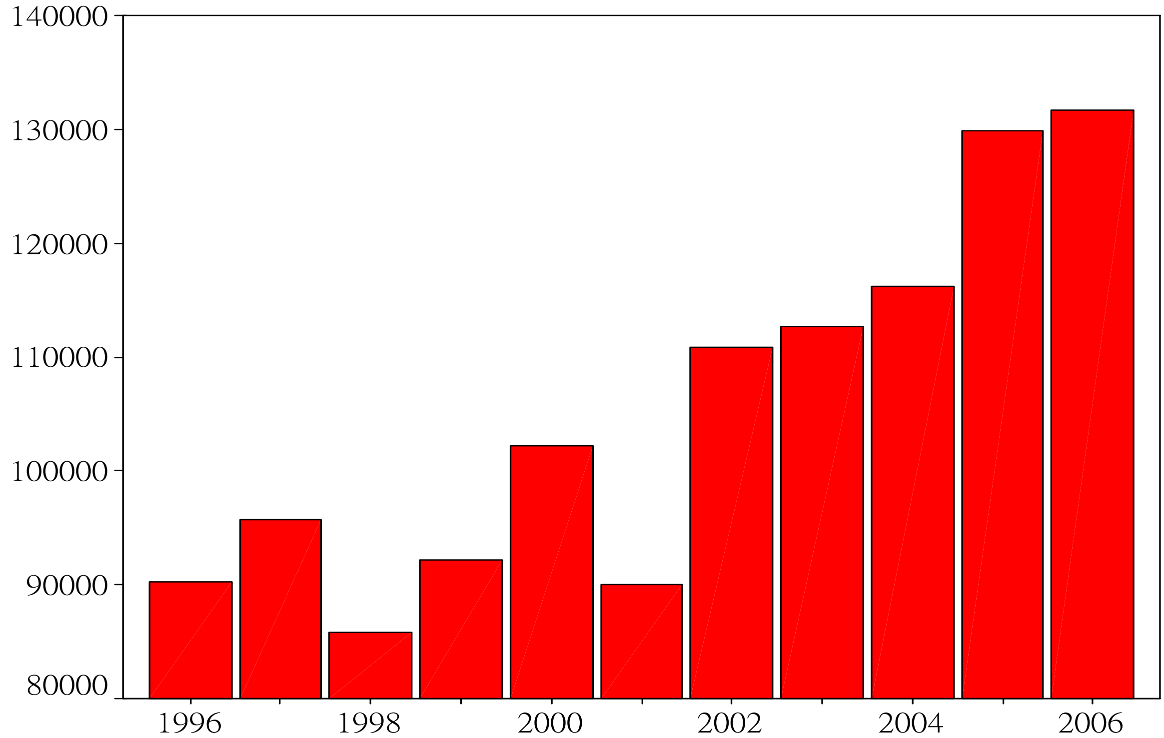

Figure 1. Nuisance Petition Cases
Source: Taiwan EPA (2007)

The current assessment on environmental impact is undertaken by calculating environmental damages by linking impact categories with particular types of process through the use of environmental indices that are based on the selection of a number of key parameters or weighting factors that are analyzed and determined through scientific analysis in association with the impact on ecosystem, resource consumption and human health. Scaling or weighting in each environmental impact category is predetermined and the job of assessors is to aggregate the data and form an overall index. In other words, a data base or an inventory for data analysis is available for calculating the associated impact indices, and quantitative damages.

For example, the Eco-Indicator 95 and 99[1] present a framework to value the damage of environmental impacts, depicted in Figure 2. In this framework, the contribution

[1] Many researchers have developed the tools for the calculation of the effects and their consequent damages. For example, Eco-99 proposed three types of damages: human health, ecosystem quality, and resource scarcity.

(characterization factor) of the environmental impacts to the environmental effect and the damage is assumed to be fixed and deterministic based on the scientific analysis. For example, the green house effect of the emission of 1 kg methane is 11 times higher than that of carbon dioxide. The environmental effects are also directly linked (please see Table 3.3 in Eco-Indicator 95) and the weighting[2] among categorized damages is subjectively assumed to be equivalent by (1) One extra death per million inhabitants per year, (2) health complaints as a result of smog periods, and (3) five percent ecosystem impairment (in the long term). This choice of the weight in Eco-95 is subjective and cannot meet the practical use in developing countries.

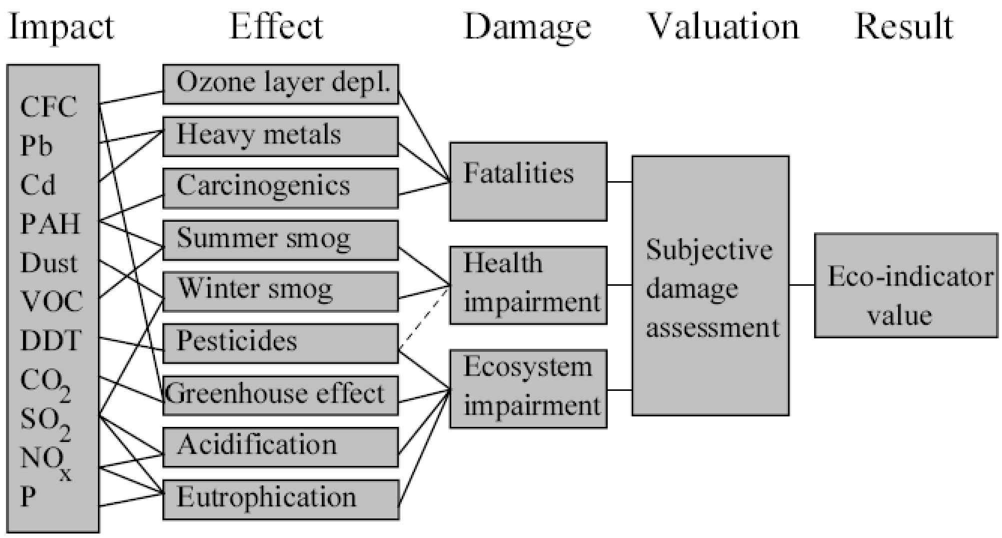

Figure 2. The framework of weighting methods by The Eco-Indicator 95

On the contrary, damage analysis in Eco-99 is conducted through different damage models to link these damage categories with the inventory result. For example, the model of Damages to Human Health is developed for respiratory and carcinogenic effects, the effects of climate change, ozone layer depletion and ionizing radiation through the conduction of Fate analysis, Exposure analysis, and Damage analysis.

In other words, the relationship of environmental effects (impact categories) to environmental damage (category endpoints) is assumed to be deterministic in regardless of individual subjective perception on damages. The selection of impact categories, category indicators and characterization models including the criteria for environmental relevance is conducted by technician groups who focus on scientific analysis in most cases. The relative weights of the three types damages are assumed to be given in Eco-indicator 95 and Eco-Indicator 99, that neglect the stakeholder, especially the neighboring residents' perception on the damage related with the project. In this paper, we propose that weighting factor should be determined by the stakeholders.

Economic valuation methods has been applied to assess environmental impacts of projects and policies in the practical world and shown to be beneficial to the EIA process. However, the use of economic methods to assess environmental impacts of projects and policies is aimed to provide a value of environmental goods in the cost benefit analysis of projects or policies so that it enable comparison between environmental protection and social and economic development to achieve more efficient use of scarce resources (Arrow et al., 1996). Strategic environmental assessment (SEA) also emphasizes to integrate the economic valuation of environmental goods in EIA (Aunan et al., 2004; Mestl et al., 2005).

Therefore, the objective of this paper is to propose a methodology to determine the weight among environmental damages through the application of Contingent Valuation Method to value

---

[2] Eco-indicator 99 considers three types of environmental damages (endpoints termed by ISO 14042) including human health, ecosystem quality and resources.

the construction of a project and apply this proposed model to determine the optimal weights on the previous cases conducted by EIA.

2. Literature review

Atkinson and Cooke (2005) focus on health impact assessment, Knaus et al. (2006) valuing ecological impacts, Ranasinghe et al. (1999) and Haider and Rasid (2002) assessing water supply options, and Uri et al. (1998), Morimoto and Hope (2004), and Wattage et al. (2000) assessing costs and benefits of various types of projects. Ramanathan (2001) use a multi-criteria method, namely the analytic hierarchy process (AHP), to combine quantitative and qualitative factors, to handle different groups of actors, to combine the opinions expressed by many experts, and can help in stakeholder analysis in the process of EIA. He proposes that AHP can work for capturing the perceptions of stakeholders on the relative severity of different socio-economic impacts. And thus it can help policy makers in prioritizing their environmental management plan, and can also help in allocating the budget available for mitigating adverse socio-economic impacts.

The current laws have not yet regulated that environmental impact assessment procedure should use monetary assessment on the project and thus the application of environmental valuation to EIA practice is still lacking of technical guidelines on how to conduct such analysis in Taiwan . In China, however, "a new national EIA law from 2002, summarized article by article in translated form in Wang et al. (2003), states that economic analysis of mitigation measures should be conducted as well as evaluation (not only analysis and prediction) of impacts "(Lindhjem, et al., 2007, p. 3). In this case, this paper attempt to build up a mathematical model with a procedural framework to support the practice of a combination of environmental valuation with EIA.

3. Research Method

Consideration of social perception on environmental impacts of development projects plays an important role in affecting the acceptance of the project from the neighboring communities and thus it has been an integral part of project evaluation cycle. The objective of social impact assessment is to identify the intended and unintended effects that arisen from the project development in order to develop sustainable policy, programs or projects (Burdge, 2003; Vanclay, 2003).

The current EIA procedure employed by Taiwan is depicted in Figure 2. in which the assessment process is categorized into two phase: Phase I assess the potential impacts based on the environmental assessments that are prepared and presented by project developers. In most cases, the potentially environmental impacts are scientifically calculated by project developers and approved by EPA. If the project required phase II EIAs, a prelinminary environmental impact statements (PEIS) should be completed by the project developer based on the detailed environmental survey, analysis and impact inventories. Before the presentation of the preliminary environmental impact statements, Taiwan EPA will invite stakeholders (the involving scholars, NGOs, the affected residents, the project developers) to define the goals and the scopes that required for the process of impact analysis and assessments according to Article 10 of Environmental Impact Assessment Act (EIAA). In this stage, the feasible alternatives, the impact items, the methods for surveying, forecasting, analysis and assessment should be determined. Based on the commonly accepted goal and scopes determined by these stakeholders, the project developer needs to present a preliminary environmental impact statements (PEIS) which contains at least: (1) the current status of the site, (2) the possible impacts and its affected scope of development, (3) the forecast, analysis and assessment of environmental impacts, (4) the corresponding strategies to minimize the impacts, (5) alternatives, (6) environmental management plant, (6) the responses to public opinions, (7) conclusions, and (8) costs for the implementation of environmental management and protection strategies. Agency of Industrial Development (AID) needs to call for a public hearing and make a filed investigation with stakeholders after reviewing PEIS. The public opinion will be transferred to EIA council (consisting of 21 members, including 7 governmental officials, 14 scholars or experts) for further evaluation. Basically, EIA council (EIAC) is independently responsible for the decision of acceptance of PEIS by subjectively allocating the weights of each impact category and determines whether to accept or reject the project. If PEIS is approved, a detailed design and implementation of project should follow and form a formal environmental impact statement. Otherwise, cancellation of the project or the reworking of EIA process accompanied with the revision of environmental assessments (EA) with more details should be repeated.

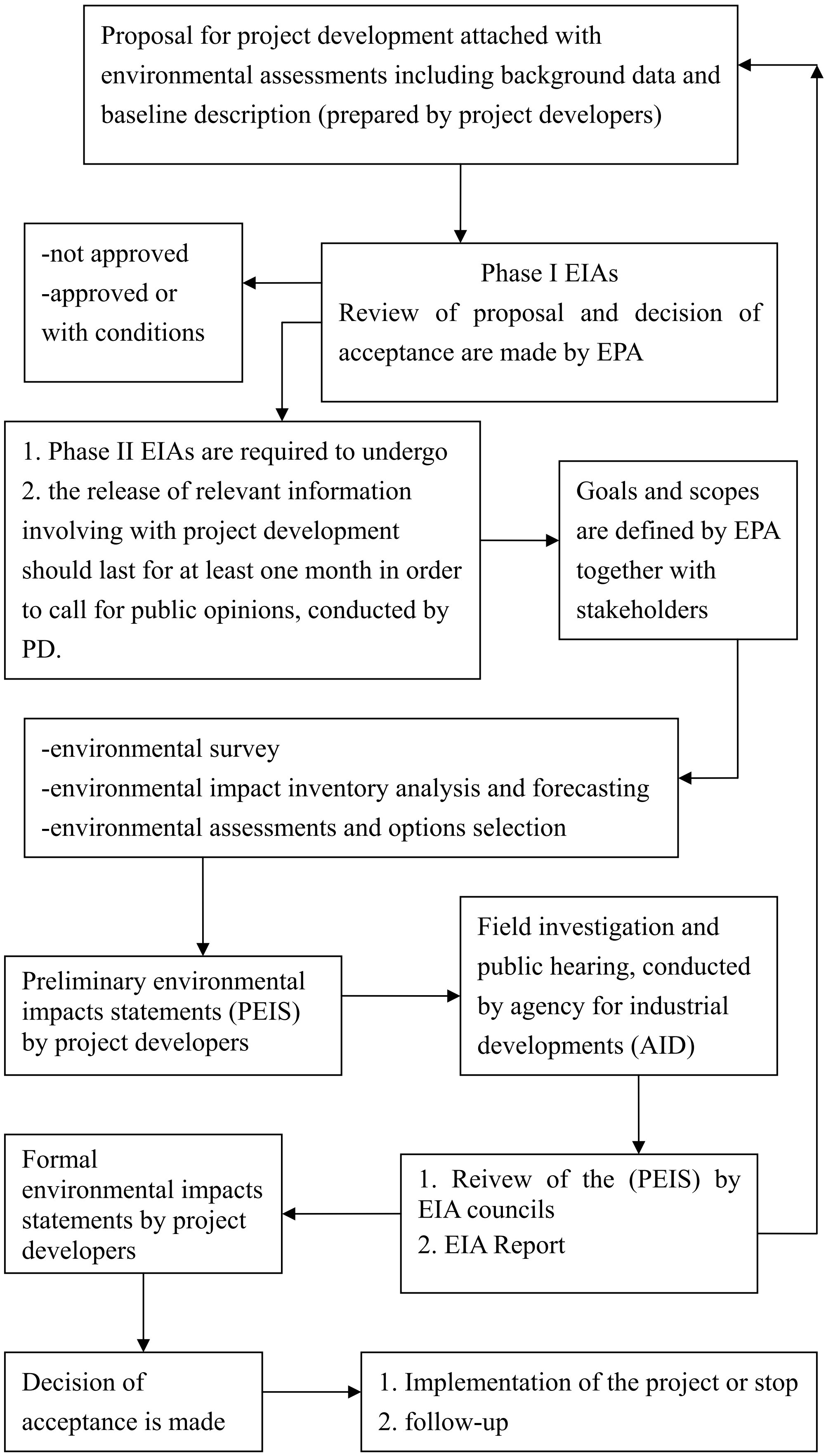

Figure 3. EIA implementation procedures currently operated in Taiwan

In the process, the stakeholder participation is allowed but they play as a monitor or a supervisor only to present different or even opposite perspectives. Eventually, whether to accept the project development is still dependent on EIAC who are supposed to be rational thinking based on scientific analysis and neglect of social impacts. In other words, the weights among the effects (benefits or damages) of impacts arisen from project development are subjectively determined by the members of EIAC.

In this paper, we propose to use a contingent valuation method to find out the tradeoffs among a variety of effects. We consider stakehodler views and attitudes toward the facility construction, allowing them to express their utility on the impacts of each impact. In this paper, stakeholders are called as "procedure committee" and EIAC is called technical committee. Procedure committee play as representatives of the stakeholders to express their preference toward each impact while technical committee consider the causal effects of impacts and calculate the aggregate costs of each impact based on scientific model. Each items of the factors in the questionnaire are prepared by technical committee that stands for technical perspectives and focus on the scientific evidence of the impacts on the environment, but reviewed and screened by procedure committee that stands for political consideration and social perspectives and focus on the issues of environmental equity. In other words, technical committee may care more on the suitability, efficiency while procedure committee focus more on the service quality, resident's acceptability and satisfaction, and adequacy of the planned project.

4. the application of CVM to derive the weighting factor

Methodologies for valuing environmental goods are in general categorized into two broad categories: stated preferences by asking people directly to value an object, for example in a so-called contingent valuation (CV) survey their WTP for hypothetical environmental changes, and revealed preferences by observing people acting in real-world settings, deriving indirectly how people value different aspects of the environment, for example, travel cost methods and hedonic price methods. The main aim of environmental valuation is to enable comparison between environmental protection and social and economic development to achieve more efficient use of scarce resources and less impact to the human health and ecosystem quality (Mestl et al., 2005, Arrow et al., 1996). In this paper, a CVM method is adopted to evaluate the weights among the three damages.

This paper assume that production of public good y (for example, incineration service for Municipal solid waste) exhibits by a Cobb-Douglas function, expressed as

$$y = A \sum_{i,j} z_i^{\alpha_i} x_j^{\beta_j} \quad \text{for } i = 1, 2, \dots, m, \quad j = 1, 2, \dots, n \qquad (1)$$

where z_i represents the ith resource input for the production of y and x_j is the jth emissions from the system, which is inevitably accompanied by the production of y. A representative agent is responsible for EIA for the project for production y by seeking to maximize the utility function U(Y, H, Q, R) which is continuous and quasi-concave, where H represents consumer health, Q is the environmental quality and R denotes the resource scarcity. The first order condition for the optimality problem yields

$$\frac{\partial U}{\partial z_i} = \frac{\partial U}{\partial y}\frac{\partial y}{\partial z_i} + \frac{\partial U}{\partial R}\frac{\partial R}{\partial z_i} = 0 \quad \text{for } i = 1, 2, \dots, m \qquad (2)$$

$$\frac{\partial U}{\partial x_j} = \frac{\partial U}{\partial y}\frac{\partial y}{\partial x_j} + \frac{\partial U}{\partial H}\frac{\partial H}{\partial x_j} + \frac{\partial U}{\partial Q}\frac{\partial Q}{\partial x_j} = 0 \quad \text{for } j = 1, 2, \dots, n \qquad (3)$$

According to Eco-99, the damage of human health H, ecosystem quality Q and resource scarcity R can be calculated by the following linear model:

$$H = \sum_j \delta_j x_j , \qquad (4)$$

$$Q = \sum_j \gamma_j x_j , \qquad (5)$$

$$R = \sum_i \tau_i z_i \qquad (6)$$

where δ_j and γ_j are the coefficients for the conversion of pollution emissions (impacts, released by the production of y) to damage of human health and ecosystem quality respectively, τ_i is the conversion factor for the calculation of resource scarcity, attributed by the ith resource consumption. All these three types coefficients are determined by scientific experimental methods and thus they are given and can be obtained from appropriate source of data bases. Thus, Substituting Eq. (4), (5) and (6) into Eq. (2) and (3) yields

$$\frac{\partial U}{\partial z_i} = \frac{\partial U}{\partial y} A \alpha_i \sum_{i,j} z_i^{\alpha_i - 1} x_j^{\beta_j} + \frac{\partial U}{\partial R} \tau_i = 0 \qquad \text{for i = 1, 2, … , m} \qquad (7)$$

$$\frac{\partial U}{\partial x_j} = \frac{\partial U}{\partial y} A \beta_j \sum_{i,j} z_i^{\alpha_i} x_j^{\beta_j - 1} + \frac{\partial U}{\partial H} \delta_j + \frac{\partial U}{\partial Q} \gamma_j = 0 \qquad \text{for j = 1, 2, …, n} \qquad (8)$$

As there are m+n variables and the same number of equations, the optimal value of $(z_1, z_2, \ldots, z_m, x_1, x_2, \ldots, x_n)$ can be obtained by the simultaneous equations of Eq. (7) and Eq. (8).

In Eq. (7) and (8), $\frac{\partial U}{\partial y}, \frac{\partial U}{\partial R}, \frac{\partial U}{\partial H}$ and $\frac{\partial U}{\partial Q}$ denote the representative decision-maker's subjective perception of marginal value on the product y, the damage of resource scarcity, human health and ecosystem quality. Traditionally, many research use economic methods to value environmental damages of projects but Eco-99 uses a scientific analysis to determine amount of categorized damages and the weighting factor among damages. It completely ignores the stake holder's perception or subjective valuation on the damaged arising from diverse environmental effects. Letting $w_1 = \frac{\partial U}{\partial R} / \frac{\partial U}{\partial y}$, $w_2 = \frac{\partial U}{\partial H} / \frac{\partial U}{\partial y}$, $w_3 = \frac{\partial U}{\partial Q} / \frac{\partial U}{\partial y}$ representing the weight of each environmental damages attributable to the perception of an individual utility, which can not be observed. In this paper, we propose that the weight of w_1, w_2 and w_3 should be decided by stakeholders.

Suppose that the project has been approved and operating. This implies that the weight has been decided and the optimal value of resource consumption and emissions $(z_1, z_2, \ldots, z_m, x_1, x_2, \ldots, x_n)$ is determined. Therefore, the utility of the project is given, thus, we get

$$0 = dU = \frac{\partial U}{\partial y} dy + \frac{\partial U}{\partial R} dR + \frac{\partial U}{\partial H} dH + \frac{\partial U}{\partial Q} dQ \qquad (9)$$

Rearranging Eq. (9) and substituting the sign of differention by difference yields

$$0 = \Delta y + (\frac{\partial U}{\partial R} / \frac{\partial U}{\partial y}) \Delta R + (\frac{\partial U}{\partial H} / \frac{\partial U}{\partial y}) \Delta H + (\frac{\partial U}{\partial Q} / \frac{\partial U}{\partial y}) \Delta Q$$

$$= \Delta y + w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q = 0 \qquad (10)$$

An individual will choose 'yes' to accept the project of an incineration plant when he feels $\Delta y + w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q \geq 0$. In other words, the indirect utility for the construction of the project is equal to the indirect utility without the construction, i.e.

$$V_1(I + \Delta y + w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q \mid X, \varepsilon) = V_0(I \mid X, \varepsilon) \qquad (11)$$

where I is the disposable income, X is a vector of observed social demographic characteristics, V_1 and V_0 are indirect utility function and may have the same functional form. In Eq. (11), ε is a scalar variable representing the disturbance of unobserved personal characteristics u_s and the remainder disturbances including the measurement error of damages v_{st}, i.e.

$$\varepsilon_{st} = v_{st} + u_s \qquad (12)$$

Both v_{st} and u_s are assumed to be identifiably independently distributed over a normal distribution with mean zero and variance of σ_v^2 and σ_u^2 respectively, and Cov (v_{st}, u_s) = 0.

When the indirect utility function V_1 is monotone increasing for any fixed (X, ε), then there exists an inverse function Λ such that

$$I + \Delta y + w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q = \Lambda(V_0(I \mid X, \varepsilon)) \qquad (13)$$

Rearranging Eq. (13) yields

$$\Delta y = -(I + w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q) + \Lambda(V_0(I \mid X, \varepsilon))$$
$$= \phi(w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q, I \mid X, \varepsilon)$$

where △ represents the change in economic benefit, damage of human health, ecosystem quality and resource scarcity after the construction of the project. When an individual feel $\triangle y + w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q \geq 0$, he will accept the project . Since ε is unobserved, ϕ is a random variable. The respondents are requested to compare the potential benefits and damages of the project development and select an answer. The value of Δy either positive or negative, without upper or lower bound. In our model，$\triangle y$ is seen as the willingness to pay for the project that may bring about the negative damage of $w_1\Delta R + w_2\Delta H + w_3\Delta Q$. Therefore, the following discrete outcomes of the response are observable:

$$D = \begin{cases} 0, & \Delta y \geq -w_1\Delta R - w_2\Delta H - w_3\Delta Q \\ 1, & \Delta y < -w_1\Delta R - w_2\Delta H - w_3\Delta Q \end{cases}$$

Stakeholder with different age, education, class, and ethnicity may express diverse trust on the sources and shows different environmental concerns. Hence, a weight evaluation conducted by stakeholder ith different demographical characteristics may generate complete different impacts. Traditionally, dichotomous choice responses are regressed against a constant, the bid amount (BID), and a vector of socioeconomic variables (X) using a logistic function. In this paper, Δy is seen as willingness to accept, and $w_1 \Delta R + w_2 \Delta H + w_3 \Delta Q$ represent the bidding amount. Thus, the probability to accept the construction of the project is

$$\text{Prob (response = yes)} = \frac{\exp(w_1\Delta R + w_2\Delta H + w_3\Delta Q + \lambda' X, \varepsilon)}{1 + \exp(w_1\Delta R + w_2\Delta H + w_3\Delta Q + \lambda' X, \varepsilon)} \qquad (14)$$

The logistic function Eq. (20) estimates the probability that an individual is willing to accept the construction of an incinerator under a given amount of damages and a set of socioeconomic characteristics. Estimation of w_1, w_2, w_3, λ' can be conveniently carried out by maximum likelihood method. The estimated values of w_1, w_2, and w_3 are incorporated into Eq. (14) to calculate the subjective aggregate damages of a project for assessor committee decision.

5. Results and conclusions

We apply the model by asking respondents to value the relative importance among impacts to determine the weights affecting respondents' preference to the project development. We categorize the damages of impacts into three types that are clearly indicated in the questionnaire in a more concrete and concerned expression. The result shows that the stakeholders, however, concern more on the direct, immediate damages in association with human health and care less on long term, potential environmental problems such as the ecosystem impairment.

This paper provides a framework of EIA that emphasize the integration of scientific analysis and subjective utility on environmental damages arising from the development of projects. In other words, the calculation of physical impacts are conducted based on scientifically analytical methods, irregardless of stakeholder's perception while the weights among the damage of human health, ecosystem impairment and resource scarcity should be determined by stakeholders subjectively. This paper introduce Contingent Valuation Method into EIA process to satisfy current laws and regulation, but more importantly to improve the information content of Environmental Impact Statements (EIS) and enable the final decisions of project approval meets both the prevention requirement of environmental impacts and the perception of stakeholders.

The framework incorporating CVM for determination of weighting factors highlights the usefulness of EV, but also reveals important methodological, practical and institutional gaps and challenges to the wider use of EIA in Taiwan. The economic valuation method of CVM clearly demonstrates the importance of stakeholder's participation that provide an important role in determining weighting factor, that eventually affect the calculation of aggregate environmental damages and serves as a dominating role in affecting final decision of project development.

Reference

1. Arrow, KJ, Cropper, ML, Eads, GC, Hahn, RW, Lave, LB, Noll, RG, 1996. Is there a role for benefit–cost analysis in environmental, health, and safety regulation? Science 272(5259):221–2.
2. Atkinson, G, Cooke, 2005. A. Developing a framework to assess costs and benefits of health impact assessment. Environ Impact Assess Rev 25(7–8).
3. Aunan, K, Fang J, Vennemo, H, Oye, KA, Seip, HM., 2004. Co-benefits of climate policy: lessons learned from a study in Shanxi. Energy Policy 32:567–81.
4. Brown, AL., Therivel, R., 2000. Principles to guide the development of strategic environmental assessment methodology. Impact Assessment and Project Appraisal 18(3):183–9.
5. Burdge, R., 2003. The practice of social impact assessment—background. Impact Assessment and Project Appraisal 21(1):84 –8.
6. Curran, JM., Wood, C., Hilton, M., 1998. Environmental appraisal of UK development plans: current practice and future directions. Environment and Planning. B, Planning and Design 25:411 – 33.
7. Fischer, T., 2002. Strategic environmental assessment performance criteria—the same requirements for every assessment? Journal of Environmental Assessment Policy and Management 4(1):83– 99.
8. Haider, W., Rasid, H., 2002. Eliciting public preferences for municipal water supply options. Environ Impact Assess Rev 22 (4):337–60.
9. Hazell, S., Benevides, H., 2000. Toward a legal framework for SEA in Canada. In: Partidario MR, Clark C, editors. Perspectives on strategic environmental assessment. New York: Lewis.
10. Knaus, M, Löhr, D, O'Regan, B., 2006. Valuation of ecological impacts—a regional approach using the ecological footprint concept. Environ Impact Assess Rev 26(2):156–69.
11. Lindhjem, H., Hu, T., Ma, Z, Skjelvik, J. M., Song, G, Vennemo, H, Wu, J., Zhang, S., (2007). Environmental economic impact assessment in China: Problems and prospects. Environmental Impact Assessment Review 27, 1–25.
12. Mestl, HES, Aunan, K, Fang, J, Seip, HM, Skjelvik, JM, Vennemo, H., 2005. Cleaner production as climate investment—integrated assessment in Taiyuan City. Journal of Clean Production13:57–70.
13. Morimoto, R, Hope, C., 2004. Applying a cost–benefit analysis model to the Three Gorges project in China. Impact Assess Proj Apprais 22(3):205–20.
14. Nitz, T., Brown,AL., 2000. SEA must learn how policy making works. Journal of Environmental Assessment Policy and Management 3(3):329 –492.
15. Noble, BF., 2000. Strategic environmental assessment: what is it and what makes it strategic? Journal of Environmental Assessment Policy and Management 2(2):203 – 24.
16. Noble BF. Strategic environmental assessment of Canadian energy policy. Impact Assessment and Project Appraisal 2002;20(3):177– 88.
17. Noble, Bram F., Strategic environmental assessment quality assurance: evaluating and improving the consistency of judgments in assessment panels, Environmental Impact Assessment Review. 24 (2004) 3 –25.
18. Noble BF, Storey K. Towards a structured approach to strategic environmental assessment. Journal of Environmental Assessment Policy and Management 2000;3(4):483 – 508.

19. Partidario, MR., 2000. Elements of an SEA framework—improving the added-value of SEA. Environmental Impact Assessment Review 20:647–63.
20. Ramanathan, R., (2001). A note on the use of the analytic hierarchy process for environmental impact assessment. Journal of Environmental Management 63, 27–35
21. Ranasinghe, M, Bee-Hua, G, Barathithasan, T., 1999. Estimating willingness to pay for urban water supply: a comparison of artificial neural networks and multiple regression analysis. Impact Assess Proj Apprais 17(4):273–81.
22. Uri, ND, Atwood, JD., 1998, Sanabria J. An evaluation of the environmental costs and benefits of conservation tillage. Environ Impact Assess Rev 18(6):521–50.
23. Vanclay F. 2003. International principles for social impact assessment. Impact Assessment and Project Appraisal 21(1):5–11.
24. Verheem, R., Tonk, J., 2000. Strategic environmental assessment: one concept, multiple forms. Impact Assessment and Project Appraisal 19(3):177 –82.
25. Wattage, P., Smith, A., Pitts, C., McDonald, A., Kay, D., 2000. Integrating environmental impact, contingent valuation and cost–benefit analysis: empirical evidence for an alternative perspective. Impact Assess Proj Apprais 18(1):5–14.
26. Wang, Y., Morgan, R. K., Cashmore, M., 2003. Environmental impact assessment of projects in the People's Republic of China: new law, old problems. Environ Impact Assess Rev 23:543–79.